

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-010743

(43)Date of publication of application : 16.01.1998

(51)Int.Cl.

G03F 7/11  
G03F 7/38  
G03F 7/38  
H01L 21/027

(21)Application number : 08-167059

(71)Applicant : FUJITSU LTD

(22)Date of filing : 27.06.1996

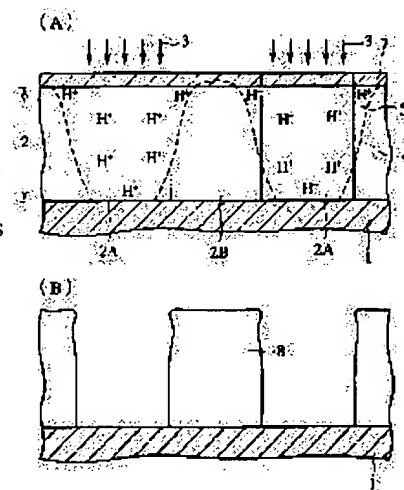
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## (54) RESIN COATING MATERIAL AND RESIST PATTERN FORMING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain such a resin coating material and a forming method of a resist pattern that reduction of a film can be decreased and a pattern having a square cross section can be obtd. by a simple means when a chemically amplifying resist is used to form a pattern.

SOLUTION: A chemically amplifying resist film 2 is formed on an object 1 for etching, and the film is subjected to first heat treatment. Then a resin coating material 7 containing a nonwater soluble resin having a small water content (e.g. a polyolefin polymer) and a basic compd. (e.g. aromatic amine, aliphatic amine and alkylamine) is applied on the chemically amplifying resist film 2. The films are exposed according to a pattern and subjected to second heat treatment. Then the resin coating material film 7 is peeled and the resist film is developed.



## LEGAL STATUS

[Date of request for examination]

29.08.2002

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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CLAIMS

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[Claim(s)]

[Claim 1] Resin coating material which the resin and basic compound of non-water solubility are contained, and is characterized by the bird clapper.

[Claim 2] With the process which performs first heat treatment after forming a chemistry amplification resist film on a substrate, subsequently With the process which forms the resin coating material film with which it comes to contain the resin and basic compound of non-water solubility on the aforementioned chemistry amplification resist film, subsequently The resist pattern formation method which the process which performs second heat treatment after performing pattern exposure, and the process which subsequently develops negatives after exfoliating the aforementioned resin coating material film are included, and is characterized by the bird clapper.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the method of forming a resist pattern using a resin coating material effective in forming a detailed resist pattern, and its resin coating material in the lithography technology used by the manufacturing process of a semiconductor device.

[0002] Although it is not necessary to say that high integration is demanded of a semiconductor device now, in order to realize it, the technology which makes a circuit pattern detailed is required, for example, short-wavelength-izing of exposure wavelength, high-resolution-izing of a resist, low reflection-ization of a substrate, etc. are called for.

[0003] Although a development field, such as using DUV (deep ultraviolet) light about short wavelength-ization of exposure wavelength, for example, will be restricted, here About a resist, development of the chemistry amplification resist containing a photo-oxide generating agent is performed briskly. about low reflection-ization of a substrate Development of various BARC (bottom anti reflective coating) material is just going to further, and this invention can be contributed to an improvement of the technology which forms a detailed pattern using a chemistry amplification resist.

[0004]

[Description of the Prior Art] Generally, when forming a pattern using a chemistry amplification resist, a resist film is formed with the application of the spin applying method, first heat-treatment (prebake) is given to the resist film, and, subsequently a pattern is exposed by ultraviolet rays or far ultraviolet rays.

[0005] In a chemistry amplification resist, an acid is usually generated only into an exposure portion. to the second heat-treatment after exposure (post exposure bake:PEB) therefore Since the generated acid solubilizes a base-material resin in the case of a positive resist, a pattern is formed and this acid generated in process can solubilize many base-material resins as a catalyst if negatives are developed, high sensitivity-ization of a resist is attained.

[0006] Although it will be thought that a detailed pattern can be formed easily if a chemistry amplification resist is used as long as it described above, various problems arise in a substantially.

[0007] That is, since it is a thing using the catalytic reaction of an acid, and the acid generated after exposure therefore deactivates in the aforementioned basic molecule and a resist front face insolubilizes a chemistry amplification resist at the time of development when a coat is formed and a front face is polluted with basic molecules, such as ammonia in air, and an amine, poor resolving of a pattern and line breadth change take place.

[0008] The basic molecule in this air has a possibility that it may not restrict that it is always fixed concentration in a clean room, therefore a pattern may change by lot-to-lot.

[0009] In order to avoid this, applying an acid or neutral resin coating material which protects a resist front face from the basic molecule in air is performed.

[0010]

[Problem(s) to be Solved by the Invention] Since poor resolving of a pattern, line breadth change, etc. take place under the influence of the basic molecule in air and pattern formation may be unable to be realized as a design when a chemistry amplification resist is used simply as described above, applying and protecting an acid or neutral resin coating material on a resist front face is performed.

[0011] However, since it originates in change of the focus in an aligner, or a gap of the focus resulting from the level difference in a wafer and the contrast of an optical image falls when a means to apply the aforementioned resin coating material is taken, it is difficult to maintain a resist in a good configuration [ the latus range of a focus ], and there are few margins of the resist configuration over a gap of the focus in an aligner.

[0012] Since poor resolving is produced when it completely generates similarly and a basic molecule exists superfluously, if a basic molecule does not exist at all even if it is the case where a resin coating material film is not used, the fall of such the depth of focus will be generated similarly.

[0013] Drawing 10 is an important section cutting side elevation showing the resist film in the process key point for explaining the case where exposure was performed in the state of defocusing, and a pattern is formed.

[0014] Drawing 10 (A) expresses the state where it exposed, and the wavelength by which 1 was irradiated by in a chemistry amplification resist film and 2A an exposure portion and 2B minding an unexposed portion and 3 minding [ an etching object and 2 ] a mask shows the proton acid therefore generated for the DUV light of 248 [nm] and 4 to irradiate an optical on-the-strength profile, and for 5 irradiate DUV light, respectively.

[0015] In the state of defocusing, it originated in the contrast of an optical image falling, and, therefore, the proton acid 5 has occurred in the front face of unexposed partial 2B at the wraparound of DUV light so that clearly from drawing.

[0016] Drawing 10 (B) expresses the state where negatives were developed, and 6 shows the resist pattern which carried out film decrease.

[0017] Since the proton acid 5 shown in drawing 10 (A) carries out the operation except the protective group in the base-material resin of a resist after PEB, when it develops negatives, it will dissolve a resist in a developer easily.

[0018] As described above, the resist pattern 6 which carried out film decrease will be formed so that the dissolution of a resist may take place and a proton acid 5 may be looked at by drawing 10 (B) also there, since it has generated also on the front face of unexposed partial 2B.

[0019] this invention is taking an easy means, in case a pattern's is formed using a chemistry amplification resist, and has little film decrease, and the pattern with which the cross section makes a rectangle is obtained.

[0020]

[Means for Solving the Problem] In case a pattern is formed in this invention using a chemistry amplification resist film, a resist film front face is kept basic very slightly before the exposure or during exposure, the acid generated into an exposure portion is made to deactivate slightly, and solubilization of a resist is suppressed, consequently there is little film decrease, and it has been to foundations to realize the resist film with which the cross section consists of a pattern which makes a rectangle.

[0021] Drawing 1 is an important section cutting side elevation showing the composition near [ in the process key point for explaining the principle of this invention ] the resist film, and the sign and this sign which were used in drawing 10 shall express a part for the said division, or shall have the same meaning. In addition, exposure should be performed in the state of defocusing also in this case.

[0022] Drawing 1 (A) expresses the state where it exposed, 7 shows the resin coating material film which depends on this invention, and this resin coating material film 7 has very slight basicity.

[0023] Also in this invention, in the state of defocusing, it originates in the contrast of an optical image falling, and is completely the same as a Prior art in the front face of unexposed partial 2B in the point which a proton acid 5 therefore generates in the wraparound of DUV light so that clearly from drawing.

[0024] However, when it depends on this invention, since it deactivates in existence of the resin coating material film 7 which had basicity slightly, few proton acids 5 of contributing to the dissolution of the resist film 2 generated by the front face of the chemistry amplification resist film 2, especially the front face of unexposed partial 2B are lost.

[0025] Drawing 1 (B) expresses the state where negatives were developed, there is little film decrease and 8 shows the resist pattern with which the cross-section configuration has accomplished the abbreviation rectangle.

[0026] That the resist pattern 8 with the good configuration looked at by drawing 1 (B) is obtained depends on that the proton acid 5 generated on the front face of unexposed partial 2B therefore deactivates in existence of the resin coating material film 7 in the wraparound of DUV light, and the front face of unexposed partial 2B can maintain insolubility to it.

[0027] or [ that the resin (for example, polyolefine system polymer) and basic compound (for example, aromatic amines, fatty amines, an alkylamine system) of (1) non-water solubility are contained, and it is characterized by the bird clapper from said place in the resin coating material and the resist pattern formation method of depending on this invention ] -- [0028] [ or ]

With the process which performs first heat treatment after forming a chemistry amplification resist film on a substrate, (2) Subsequently With the process which forms the resin coating material (resin coating material seen above (1)) film with which it comes to contain the resin and basic compound of non-water solubility on the aforementioned chemistry amplification resist film, subsequently The process which performs second heat treatment after performing pattern exposure, and the process which subsequently develops negatives after exfoliating the aforementioned resin coating material film are included, and it is characterized by the bird clapper.

[0029] The resin coating material film used when carrying out this invention and forming a resist pattern Although a chemistry amplification resist insolubilizing it therefore from the outside to influence since it inhibits good that the basic molecule out of air permeates, and affecting a pattern is lost of course Originally the basic molecule of a ultralow volume is contained in the resin coating material film. Since the basic molecule goes into the surface of a chemistry amplification resist film, to the wraparound of the light which originates in the contrast of an optical image falling at the time of defocusing, and is generated therefore Even if the acid of an excessive minute amount is generated on the unexposed partial front face of a resist pattern It can contribute to solving problems, such as film decrease which the acid is made to deactivate, and a chemistry amplification resist film can be insolubilized, therefore is generated in relation to the contrast fall of the optical image at the time of defocusing.

[0030]

[Embodiments of the Invention] An example of the gestalt of the operation in this invention is explained.

[0031] (1) A diameter applies to the wafer of 15 [cm] (6 inches) KRF-K2G (tradename of JSR) which are a positive-type chemistry amplification resist made from JSR (Japan Synthetic Rubber Co., Ltd.) at the thickness of about 0.7 [μm].

[0032] (2) Perform heat treatment of temperature 80 [°C] and time 120 [a second] on a hot plate.

[0033] (3) Apply to the thickness of about 0.2 [μm] the resin coating material which depends on applying the spin coat method and depends on this invention.

[0034] (4) Perform heat treatment of temperature 60 [°C] and time 90 [a second] on a hot plate.

[0035] (5) Expose by changing a focus using the excimer laser stepper ( NSR[ by NIKON CORP. ]-2005EX8A, NA=0.5,

sigma=0.5) of wavelength 248 [nm].

[0036] (6) Perform heat treatment of temperature 100 [°C] and time 120 [a second] on a hot plate.

[0037] (7) It is immersed in a xylene (100 [%]) and exfoliate the resin coating material film which depends on this invention.

[0038] (8) Paddle development of time 60 [a second] was performed using the developer which consists of solution which makes TMAH (tetramethyl ammonium hydroxide) of 2.38 [%] a principal component.

[0039] The resin coating material of this invention used at the process which gave [aforementioned] explanation consists of basic compounds which consist of a resin of a polyolefine system, and a G cyclohexylamine (it is the concentration of 1000 [ppm] at the range of 100 [ppm] - 10000[ppm] in an opposite pitch), and the solvent is a xylene.

[0040] Moreover, as a basic compound, they are an aromatic-amines \*\* G cyclohexylamine \*\* aniline, its derivative \*\* benzylamine, and its derivative [0041]. Fatty-amines \*\* isopropylamine [0042] Alkylamines can be used.

[0043] By the resist pattern which is the above, and was made and formed, separation resolving of the cross-section configuration of 0.3 [μm] last shipment (line and space) was fully carried out in [ focal ] 2.0 [μm] (it is the range of \*\*1.0 [μm] focusing on the half of resist thickness).

[0044] Incidentally by the resist pattern formed using the Prior art, i.e., the resin coating material film of the amine concentration 0 separation resolving of the same 0.3 [μm] last shipment as the above is possible -- the inside of the focal range (it is the range of \*\*0.7 [μm] focusing on the half of resist thickness) of 1.4 [μm] -- it is -- when it did not pass but depended on this invention, improvement in a focal margin was found clearly

[0045] Drawing 2 or drawing 5 is an important section slant-face view showing the resist film for explaining the relation between the focus at the time of carrying out this invention, and a resist film cross-section configuration. In addition, each drawing traced the microphotography faithfully and created it.

[0046] The terms and conditions relevant to the sample used when this data was obtained are as follows.

The base-material resin of a chemistry amplification resist: ZCOAT (tradename : Nippon Zeon make)

Dicyclohexylamine concentration (opposite pitch): 1000 [ppm]

Pattern: 0.3 [μm] last shipment [0047] In each drawing, F shows a focal position and it will be \*\*\*\*(ed) that the case where it considers as F=-0.6[μm] is the best cross-section configuration, considering each mentioned data.

[0048] In F=-1.6[μm], in F=-1.4[μm], in drawing 2, (A) is [ (C) of (B) ] the case of F=-1.2[μm].

[0049] In F=-1.0[μm], in F=-0.8[μm], in drawing 3, (A) is [ (C) of (B) ] the case of F=-0.6[μm].

[0050] In F=-0.4[μm], in F=-0.2[μm], in drawing 4, (A) is [ (C) of (B) ] the case of F= 0.0 [μm].

[0051] In the case of F= 0.2 [μm], in drawing 5, (B) of (A) is the case of F= 0.4 [μm].

[0052] Drawing 6 or drawing 9 is an important section slant-face view showing the resist film for explaining the relation between the focus at the time of carrying out a Prior art, and a resist film cross-section configuration. In addition, each drawing traced the microphotography faithfully and created it.

[0053] In F=-1.6[μm], in F=-1.4[μm], in drawing 6, (A) is [ (C) of (B) ] the case of F=-1.2[μm].

[0054] In F=-1.0[μm], in F=-0.8[μm], in drawing 7, (A) is [ (C) of (B) ] the case of F=-0.6[μm].

[0055] In F=-0.4[μm], in F=-0.2[μm], in drawing 8, (A) is [ (C) of (B) ] the case of F= 0.0 [μm].

[0056] Drawing 9 is the case of F= 0.2 [μm].

[0057] The terms and conditions relevant to the sample used when this data was obtained are the completely same conditions as the sample used when the data of drawing 2 or drawing 5 were obtained, if it removed that dicyclohexylamine concentration (opposite pitch) was 0 [ppm].

[0058] Considering each mentioned data, the focal range is clearly narrow and it is \*\*\*\*(ed) that the cross-section configuration acquired must not be compared with the case where it depends on this invention, either.

[0059]

[Effect of the Invention] It applies during exposure from before exposure at least, and is made to cover a chemistry amplification resist film in the resin coating material and the resist pattern formation method of depending on this invention by the resin coating material film by which it comes to contain the resin and basic compound of non-water solubility with enough few moisture contents.

[0060] The resin coating material film used when carrying out this invention and forming a resist pattern Although a chemistry amplification resist insolubilizing it therefore from the outside to influence since it inhibits good that the basic molecule out of air permeates, and affecting a pattern is lost of course Originally the basic molecule of a ultralow volume is contained in the resin coating material film. Since the basic molecule goes into the surface of a chemistry amplification resist film, to the wraparound of the light which originates in the contrast of an optical image falling at the time of defocusing, and is generated therefore Even if the acid of an excessive minute amount is generated on the unexposed partial front face of a resist pattern It can contribute to solving problems, such as film decrease which the acid is made to deactivate, and a chemistry amplification resist film can be insolubilized, therefore is generated in relation to the contrast fall of the optical image at the time of defocusing.

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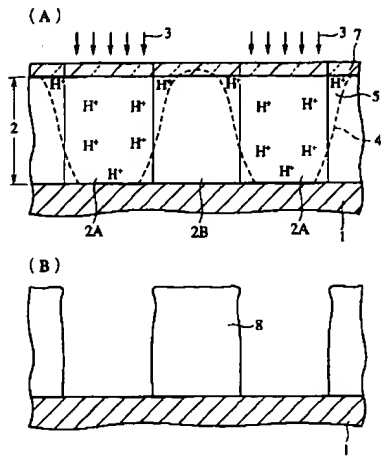
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Drawing selection

[Representative drawing]



原理を説明するレジスト膜近傍を表す  
要部切断側面図



- |              |                |
|--------------|----------------|
| 1: エッチング対象物  | 4: 光強度プロファイル   |
| 2: 化学増幅レジスト膜 | 5: プロトン酸       |
| 2A: 露光部分     | 7: 樹脂コーティング材料膜 |
| 2B: 未露光部分    | 8: レジスト・パターン   |
| 3: DUV光      |                |

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